SERIOUS INCIDENTS IN THE U.S. PETROLEUM REFINING INDUSTRY: 1985-1989

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I. Introduction and Summary

Some serious incidents in the U. S. petrochemical industry have raised public and Congressional concern for safety in the petroleum and chemical industries. Incidents related to operation or maintenance of process units are of special concern, because the unintentional release of quantities of a flammable, combustible, or toxic substance can have potentially catastrophic effects.

This paper examines several aspects of work place safety in the U. S. petroleum refining industry. Our focus is on serious incidents, that is, those that cause substantial damage to property and human life. We survey the existing public information on refining industry incidents, and provide some new information produced by a survey of U. S. refiners. Also at issue is the use of contract labor, as opposed to direct hire employees, to carry out refinery maintenance, operation, and other tasks, and what relation there is, if any, between contract labor use and the likelihood of serious incidents.

Concerns over catastrophic incidents span both the petroleum refining and petrochemical industries. This study considers only the petroleum refining industry.

Methods used A major purpose of this paper is to present results of a survey of U. S. petroleum refiners requesting information related to serious incidents. A serious incident is defined as one that resulted in either one or more fatalities or five or more hospitalizations. U. S. refining companies were surveyed to solicit information both on the refinery work force, and on the characteristics and consequences of serious incidents that occurred during the five year period 1985 through 1989.

The responding sample includes 97 percent of all currently operable refining capacity, all currently operating refineries with capacity of more than 60,000 barrels per day, and most operating refineries with more than 10,000 barrels per day capacity.

Conclusions The following conclusions apply to the sample of responding firms. Because this sample represents all medium and large refineries and nearly all operable refining capacity, statistics for the entire U. S. refining industry can be expected to differ only slightly from those below.

- In the 1985 to 1989 period, there were 66 serious incidents in the U. S. refining industry, resulting in 86 fatalities, 166 hospitalizations, and over $400 million in property damage. Forty of the 66 fatalities were process related.

- There is no apparent or statistically significant trend of incident damage over time, either upward or downward.

- Using several measures of size, larger refineries account for a slightly larger proportion of serious incidents and fatalities and a smaller proportion of hospitalizations than smaller refineries.

- Over the period studied, use of direct hire labor has decreased, and use of contract labor increased, both at rates of two to three percent per year.

- Larger refineries are more labor intensive than smaller refineries. Refineries with over 700 employees use 20% more labor per unit of capacity than refineries with less than 700 employees.

- Contract workers were at a higher risk of dying in a fatal incident than direct hire employees. In the 1985 to 1989 period, the fatality rate per hour worked was 50 percent higher for contractor employees than for direct hire employees. Seventy-five percent of direct hire employee fatalities were in process related incidents, while fifty-seven percent of contractor employee fatalities were associated with non-process related incidents.

- Contract workers worked approximately 31 percent of total hours worked in refineries. Contractors received 11 percent of the 62 citations that OSHA issued as a result of the 40 process related incidents, and contractors or contractor employees were named as contributing factors in 24 percent of process incidents, or 8 of the 34 incidents where contributing factors were identified. There is no evidence

that contractors or contractor employees are disproportionate factors in process related incidents.

- Incidents are distributed quite unevenly across individual refineries, with approximately half of all incidents in the five year period covered occurring in eleven refineries. However, this distribution is statistically indistinguishable from an independent random distribution where the probability of an incident is dependent only upon, and proportional to, refinery size.

- When compared to U. S. industry as a whole, the refining industry has a lower overall rate of lost work days from occupation related causes (about twenty percent), but a higher fatality rate. Comparison of fatality rates is made difficult by the discrepancies in estimates of numbers of employees.

The remainder of this report The remainder of this report is organized as follows. Sections II and III discuss data collection methods and present summary information on serious incidents in the U. S. petroleum refining industry. Section V discusses the numbers and composition of the refining industry work force over the period studied. Sections VI through IX examine the relationships, if any, between the incident record, and patterns over time, refinery complexity and size, and the severity of incidents. Sections X and XI present data on factors contributing to process related incidents, and the OSHA reactions to incidents. Section XII compares the refining industry record to that of other industries.

II. Public Information on Refining Industry Incidents

Information on occupational incidents and illnesses in the petroleum industry is routinely collected by several sources. These include the Bureau of Labor Statistics, the American Petroleum Institute, the National Petroleum Refiners Association, and others. Surprisingly, perhaps, in spite of the attention paid to serious incidents in the chemical and process industries, there has been little or no systematic effort to collect and analyze data on these more severe and serious incidents. As a result, public information on serious incidents that is consistent and collected periodically is limited. In particular:

> "OSHA maintains a computerized accident database known as FAT/CAT (the acronym for Fatalities/Catastrophes Accident Description Database). This database furnishes detailed information on industrial incidents where there is one or more fatality or where five or more workers are hospitalized due to injuries or illnesses that are work related. It is known that this database is incomplete because very few of the states that control their own OSHA program (i. e., State Plan states) furnish the needed data. Also, the quality of information provided for use in FAT/CAT varies greatly from state to state." [Kearney/Centaur, pages 5-2 - 5-3.]

Also, the John Gray Institute report for OSHA on contractor safety concluded, in its "Recommendation 2", that:

> "OSHA Should Work with Management and Labor to Create a Collaborative, Comprehensive, Proactive Data Collection System. The present methods of data collection and the subsequent attempts to utilize these data to effect positive safety and health outcomes in the petrochemical industry are wholly inadequate." [Wells *et al.*, July 1991, page 196]

The U. S. Department of Commerce Bureau of Labor Statistics (BLS) publishes annual statistics on occupational incidents and illnesses including numbers of cases and numbers of lost workdays, and rates of incidence. The API publishes an annual survey of injuries and fatalities [API, annually through 1990]. Table 1 lists some of the statistics from the 1980 to 1989 API surveys. The responding sample of firms is self-selecting, and not necessarily comparable from year to year, making it difficult at best to establish trends, indices, or incidence rates. Only a portion of the industry is represented; the sum of refining industry fatalities reported for the 1985-89 period, for example, is half the total for the same years from the survey reported on below.

The National Petroleum Refiners Association surveys its members annually for safety related information [NPRA, 1990]. While the NPRA sample has a measure of year to year consistency, the fraction of the entire refining industry represented is well under 100 percent. For example, the refinery incident fatalities reported for 1989 were just over half the total reported in the survey detailed below.

III. Data Collection Methods

The purpose of this section is to explain the methods used to collect information from U. S. refiners about serious refinery incidents. This report deals with incidents in petroleum refineries, and excludes, insofar as possible, chemical and petrochemical manufacturing facilities. It should be noted that many of the policy questions and overall safety concerns encompass both petroleum refineries and petrochemical facilities (and perhaps other types of facilities as well), and do not necessarily distinguish among categories. This report presents information only for petroleum refineries.

Survey methods

A request for information was sent to every known and identified operating refining company. The list of candidate refineries, along with information on ownership and status, is given in Appendix 2. The

cover letter and questionnaires are reproduced in Appendix 1. Candidate refiner information was gathered from USDOE [1990], and Pennwell [1990], and other sources. Requests for data were sent to 113 refining companies. A number of other companies were identified from the various lists of refineries, but were not sent requests, either because they were no longer in existence, or because no verifiable address or phone number could be found. As part of the cover letter to each refining company, the location and crude oil distillation capacity and ownership record for each refinery owned by that company was listed. The cover letter asked the respondent to verify the information on ownership, location, and capacity.

An attempt was made to contact all initial non-respondents, to verify receipt of the request for data and to solicit their reply.

Each refining company was asked to complete a refinery questionnaire for each refinery that it owned and operated, and one incident questionnaire for each serious process related incident that occurred during the years 1985 through 1989. A serious incident was defined as an incident that either killed one or more persons or resulted in the hospitalization of five or more persons. This is the criteria that OSHA uses to trigger reporting (see below IV). A process related incident was defined as "any incident that is associated with a fire, explosion, or uncontrolled or unintentional release of energy or a hazardous or harmful substance." Process related incidents are of particular concern because the release of quantities of a hazardous substance has potentially catastrophic consequences.

Characterization of the Responding Sample

Refineries who responded to the survey request account for the bulk of current operable U. S. refining capacity. Responses were received from 84 percent of the operable refineries, and comprise 97 percent of the operable capacity and 99 percent of the catalytic cracking capacity. In particular, re-

Table 1 - API Survey of Refining Industry Injuries and Fatalities

Year	Number of Employees	Hours Worked	Injuries	Fatalities	Number of Days Away From Work
1980	82,648	156,371	4,402	9	25,424
1981	87,163	180,735	4,543	8	25,094
1982	83,776	165,971	3,899	8	27,091
1983	78,433	162,262	3,312	7	22,708
1984	72,702	147,418	2,464	24	20,922
1985	70,212	143,686	2,409	7	17,985
1986	41,361	84,147	2,498	5	9,075
1987	46,214	93,940	3,165	6	17,904
1988	43,065	94,433	2,856	12	17,498
1989	46,143	95,303	2,700	13	13,257

Source: API, Summary of Occupational Injuries, Illnesses, and Fatalities in the Petroleum Industry, 1990 and prior years.

sponses were received from all operating refineries with crude distillation capacity of 60,000 barrels per day or more. Table 2 summarizes the characteristics of the responding sample and compares the sample to the U. S. refinery population as a whole.

There is no *a priori* reason to expect the refiners who responded to have the same characteristics or incident record as those who did not. Assuming that the population of respondents is similar to non-respondents may not be correct. In particular, the firms and refineries who did respond are larger than those who did not. Although this is a potential source of bias, it is expected to be small, in part because the respondents represent most of U. S. refining capacity. An additional potential source of bias results from the fact that a number of refineries that operated some time during the 1985 to 1989 period are now shut down or no longer in existence. This number is greater in earlier years than later. However, unless the mostly smaller non-responding refineries have a radically different safety record, the responding sample provides a reasonable picture of the refining industry over the period surveyed.

IV. Characterization of Serious Refinery Incidents

The purpose of this section is to present summary information on the number, nature, and consequences of serious refinery incidents in the U S. Information on the incidents themselves is from the survey of incidents described above for the years 1985 through 1989. Information on refinery capacity and other characteristics is from public sources.

In the 1985 to 1989 time period, survey respondents reported forty process related incidents and twenty-six incidents that were not process related, all of which met the definition of serious incident mentioned above. Table 3 summarizes some of the characteristics of these incidents. In total, the incidents accounted for 86 fatalities and 166 hospitalizations. Reported property damage for the process related incidents was $437.2 million. Information on estimated property damage from non-process related incidents was not solicited.

Table 4 shows the numbers of fatalities and hospitalizations over the period according to whether the persons affected were direct hire employees, contract workers, or third parties. The bulk of the fatalities (59 percent) were direct hire employees. There were no third party fatalities. Ninety-five of the total of 166 hospitalizations were to third parties. All of the 95 resulted from a single incident. Property damage totals were reported for 32 of the 40 process related incidents. For these 32 incidents, reported property damage to owners was $388 million, and damage to third parties was $49 million, for a total of $437 million, an average of $13.7 million per incident.

For thirty-seven of the forty process related incidents, respondents indicated the nature of the substance released in the incident. Very few (responses gave the amount released, although in many cases the accompanying narrative indicated qualitatively whether the amount was small or large.

Table 5 shows the number of incidents, fatalities, and hospitalizations associated with each category of released substance. The two substance categories with the largest number of incidents or fatalities are light hydrocarbon gases and naphtha range hydrocarbons. These two categories together account for about half of the incidents and fatalities. Ninety-five of the 160 hospitalizations are from an incident where hydrofluoric acid was released. Water or steam was the substance released in three incidents associated with three fatalities and one hospitalization. Heavier oils accounted for five incidents with ten fatalities and seven hospitalizations.

V. The Refining Industry Work Force: Use of Direct Hire and Contractor Workers

Figure 1 shows refining industry employment and capacity from 1980 through 1989, as reported by the Bureau of Labor Statistics (BLS). Employment peaked at 173 thousand in 1981. It was 118 thousand in 1989, or 32% lower. Refining capacity also decreased over this period, although not by as great a fraction. The employment numbers are

Table 2 - Refinery Population and Responding Sample

	Operable Refineries			Shutdown, Idle, & Other		
	number (%)	crude dist. capacity (%)	cat. crack capacity (%)	number (%)	crude dist. cap. (%)	crack cap. (%)
Not contacted	7 (3.6)	101,400 (0.6)	0 (0)	7 (41.1)	74,500 (11.1)	0 (0)
Contacted; no response	25 (12.7)	378,607 (2.4)	42,500 (0.8)	4 (23.5)	382,600 (56.8)	110,000 (100)
Responded	165 (83.8)	15,445,707 (97.0)	5,288,391 (99.2)	6 (35.3)	216,000 (32.1)	0 (0)
Total	197 (100.0)	15,925,714 (100.0)	5,330,891 (100.0)	17 (100)	673,100 (100.00)	110,000 (100.0)

Source: API/NPRA survey, USDOE/EIA (annual editions), and Pennwell [1990]
Notes: Numbers and capacities are as of January 1, 1991. "Shutdown, idle, and other" category includes four refineries whose precise status is not known. Percentages may not add to 100 because of rounding.

Table 3 - Serious Refinery Incidents, 1985-1989

Characteristic:	process related	non-process related	total
Number of incidents	40	26	66
Number of fatalities	60	26	86
Number of hospitalizations	161	5	166
Number of refineries involved	31	17	41
Est. prop. damage ($ mill.)			
to owner:	$388.2	(*)	(*)
to third party:	$49.0	(*)	(*)

Source: API/NPRA Survey.

Notes: Totals for numbers of refineries involved do not add because of multiple incidents in some refineries during the reporting period. (*) indicates that information was not collected. Total for number of refineries involved is not equal to row sum because some refineries reported both process related and non-process related incidents.

Table 4 - Refining Industry Deaths and Hospitalizations, 1985-1989, by Affected Party

	Deaths		Hospitalizations	
	Process	Non-proc.	Process	Non-proc.
Employees	45	6	23	0
Contractors	15	20	43	5
Third Parties	0	0	95	0
Total	60	26	161	5

Source: API/NPRA survey

Table 5 - Substances Released in Process Related Incidents

Substance released:	number	fatalities	hosp's.
Nitrogen	1	1	0
Hot water or steam	3	3	1
Hydrofluoric acid	1	0	95
Hydrogen	2	4	2
Hydrogen sulfide or H_2S/ hydrocarbon mixture	4	4	2
Hydrogen and naphtha	2	7	13
Hydrocarbon gases	10	17	12
Naphtha range hydrocarbons	8	10	28
Sodium hydroxide	1	1	0
Heavy oils	5	10	7
Total	37	57	160

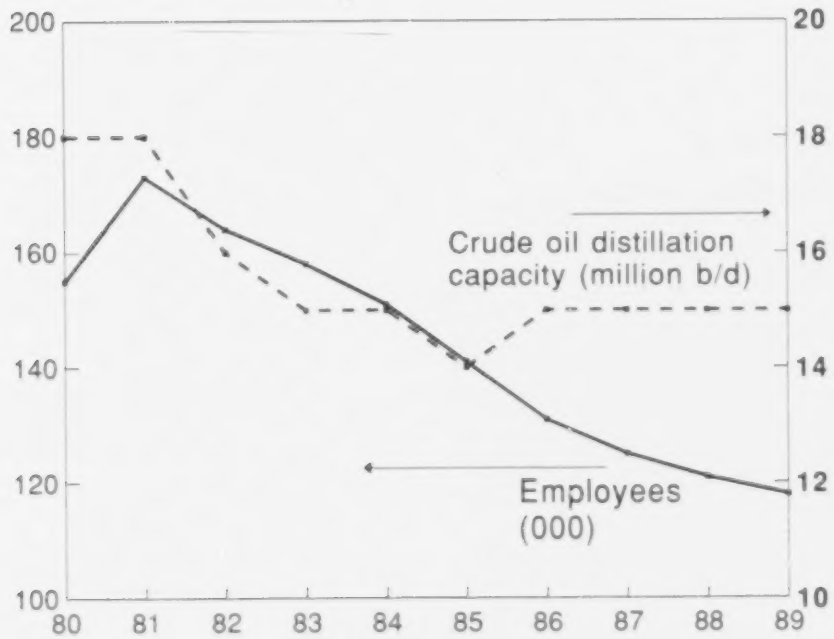
Source: API/NPRA Survey

Notes: Hydrocarbon gases include C2-C4 paraffins and olefins, and fuel gases. Naphtha range hydrocarbons include naphthas, alkylate, and hydrocarbon mixtures. Heavy oils include slop oils, slurry oil, waste water tank sludge, and hot asphalt.

from the BLS. The Independent Petroleum Association of America (IPAA) also publishes employment numbers for the refining industry. Theirs are considerably larger, by about 30% or so, e. g. 214,000 versus 172,800 in 1981, and 161,800 versus 118,100 in 1989. IPAA derives their totals from information received from state employment offices. In our data gathering effort, we estimate refinery employment at approximately 69,000 employees (see below). This number is considerably smaller than the BLS and IPAA figures. One reason for this may be that the BLS counts all employees of refining companies, while we tallied only employees at refineries. In any case, our employee count is about half that of the BLS, but is a better indicator of the actual number of direct hire employees on site and at risk from refinery incidents.

One hundred sixty-four of the 168 reporting refineries reported the current number of employees. The total number reported was 66,905. The non-reporting refineries represent a small portion of reporting capacity, so that the actual number of direct hire workers currently employed in refineries can be considered very close but slightly higher than the total of 66,905. Extrapolating the sample total to the industry as a whole using the assumption that employment is proportional to capacity gives an industry total of about 69,000 employees.

Refiners were asked to report the number of hours worked by direct hire employees and by contract workers for each of the years 1985 through 1989, on a refinery by refinery basis.



Sources: BLS, API Basic Petrol. Data Book

Figure 1 - Refining Industry Capacity and Employees, 1980 - 1989

Refiners were also asked whether records of contractor hours were kept and available, and if the contractor hours were estimated, to explain how they made the estimates.

Table 6 and Figure 2 show the year by year hours worked by contract and direct hire employees. The table also breaks refineries into two groups: those with over 700 employees, and those with 700 or fewer employees. The purpose of this division is to determine whether there are noticeable differences between large and small refineries in the use of contract labor.

The number of direct hire hours worked decreased between 1985 and 1989 by 9.7 million hours, or an annual rate of decrease of about 2.5 percent. During this period the number of contractor hours increased by 5.4 million hours, at an annual rate of increase of 3.3 percent. Overall hours worked decreased in 1986 and 1987, and increased thereafter in the next two years to close to the 1985 level. Thus, at least during the period studied, refiners increased their use of contract labor and decreased their use of direct hire labor. The rate of change over the period for direct hire and contract labor was about two and three percent, respectively, although year to year changes were considerably more variable. Specifically, most of the changes over the period are accounted for by the large decrease in both direct hire and contract hours worked from 1985 to 1986, and the increase

Table 6 - Direct Hire and Contract Labor Hours

	Millions of Labor Hours Worked in Year:				
By:	1985	1986	1987	1988	1989
Smaller refineries					
direct hire	42.45	38.98	38.80	39.28	39.70
contract	15.44	13.27	16.23	16.54	18.36
(percent)	(26.7)	(25.4)	(29.5)	(29.6)	(31.6)
total	57.89	52.24	55.03	55.83	58.06
Larger refineries					
direct hire	53.71	48.25	46.91	46.33	46.79
contract	24.90	22.07	20.02	25.94	27.35
(percent)	(31.6)	(31.4)	(29.9)	(35.9)	(36.9)
total	78.62	70.33	66.93	72.27	74.15
All refineries					
direct hire	96.30	87.37	85.84	85.74	86.62
contract	40.35	35.34	36.25	42.48	45.72
(percent)	(29.5)	(28.8)	(29.7)	(33.1)	(34.5)
total	136.65	122.27	122.09	128.22	132.33

Source: API/NPRA Survey
Notes: Larger refineries are those with more than 700 employees, and smaller with 700 or less. Approximately two thirds of responding sample (by capacity) reported contractor hours worked.

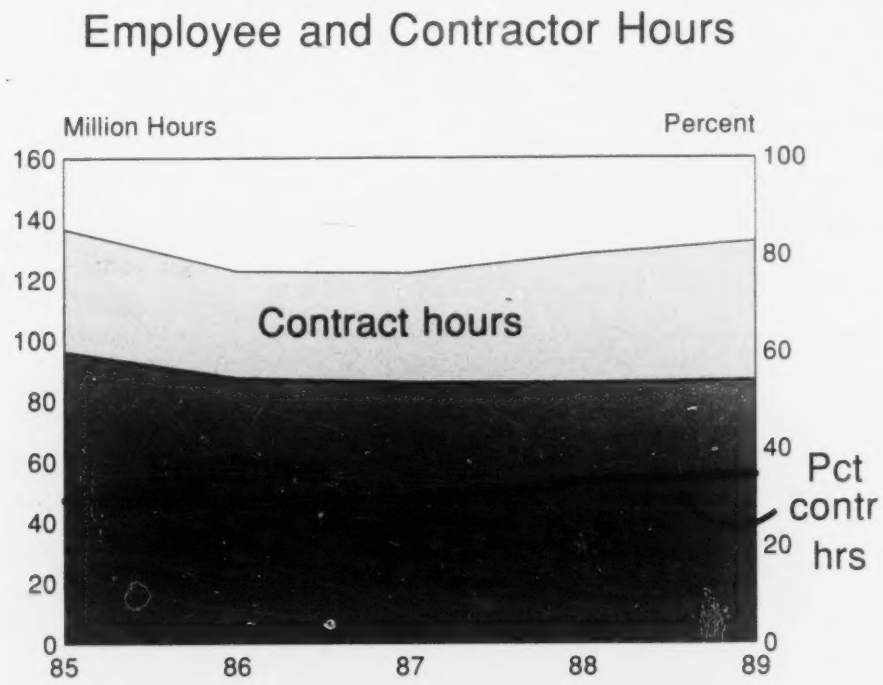


Figure 2 - Employee and Contractor Hours Worked

in contractor hours worked from 1987 to 1988.

The refinery population was broken into two groups, with less than or more than 700 employees, because this break point gave a roughly equal division in overall capacity (51% of capacity in smaller and 49% in larger refineries). The group of smaller refineries had a relatively smaller number of employees than the larger refineries, with 45% of the total. A more appropriate index of labor intensity may be total hours worked per year, per barrel of daily capacity. By this measure, in 1989, the smaller refinery group averaged 12.3 hours worked per year per daily barrel of capacity, while the larger refineries averaged 14.8 hours per daily barrel per year, or 20% more. This greater use of labor by larger refiners may reflect the greater complexity of larger refineries, and greater value added per barrel.

Table 6 indicates that the larger refineries, e. g., those with 700 or more employees, used a somewhat higher proportion of contract labor than the smaller refiners. The percentage of contractor hours as a percent of total hours was higher for the larger firms in each year, with the differences in the percentage of contractor hours worked ranging from less than one percent in 1987, to five or six percent in other years.

The overall contract labor percentage of 29 to 34 found here is generally consistent with the John Gray Institute (JGI) Report conclusion that "Contract workers account for a reported 32 percent of the workhours performed during non-turnaround

periods and 54 percent of the workhours during turnaround periods." [Wells et al. 1991, page xv]. The JGI report's universe consists of both refining and chemical plants, while only refineries are considered here.

While almost all refineries had records of direct hire employee hours worked (154 refineries with 14.4 million barrel per day capacity), fewer had records available on contractor hours worked (106 refineries with 9.8 million barrels per day capacity). A significant number of those reporting contractor hours estimated the hours through the use of contract records, or from labor billings using estimated wage rates. We can expect the contractor hour estimates to be less accurate than the employee hour estimates, but have no reason to expect any bias in their magnitude. On the other hand, there is no *a priori* reason to expect that responding firms' responses for contractor hours worked are necessarily representative of the entire industry. However, the direct hire employee hours worked by the sample of firms who reported both direct hire and contractor hours tracks very closely the employee hours of all reporting firms, in both hours worked per unit of capacity and in the year to year variation in number of hours worked. For this reason, we can suppose that the characteristics of the industry as a whole are quite likely to be similar to those of the reporting sample.

Under the assumptions: (1) of an average of 2000 hours worked per "equivalent" employee; and (2) that the relative numbers of direct hire and contractor hours worked are similar for the reporting sample and for the refinery population as a whole; we can calculate the relative fatality risks for contractor and direct hire employees. Under these assumptions, the average numbers of direct hire and contract workers over the 1985 to 1989 period are 71,141 and 32,223 respectively. The total for direct hire employees estimated this way is in very good agreement with separately reported total above of 69,000, estimated from the current number of employees, rather than hours worked. The 51 employee fatalities and 35 contractor fatalities in five years imply fatality rates of 14.3 and 21.7 per 100,000 employees per year for direct hire and contract workers, respectively. The contractor rate is about fifty percent higher than the direct hire employee rate.

This contrasts with the following conclusion in the John Gray Institute report:

> "The data collected from plant managers proved to be inadequate to compare the injury experiences of direct-hire and contract workers. Less than half of the plant managers could supply injury rate data for contract workers and those data that were supplied were found to be unreliable, i. e., they were unrelated to any plant management practices and were not correlated with the injury rates of direct-hire workers in the plant.
>
> Data collected from the employees did provide a basis for analyzing the probability of injuries of the two groups. From these data we concluded that contract workers are more likely to experience incidents than direct-hire workers." [Wells et al. 1991, page xvii]

The JGI report conclusion is based on a smaller sample of a wider universe, and focuses on all incidents rather than fatalities or serious incidents.

VI. The Incident Record Over Time

Table 7 and Figure 3 show the number of incidents, fatalities, and hospitalizations by year, for process related incidents and non-process related incidents. The data for hospitalizations show a marked peak in 1987, a year in which two incidents accounted for the bulk (118) of all serious incident hospitalizations over the entire period. There is no statistically significant trend either upward or downward in either the number of incidents per year, or the number of fatalities. The record compiled here represents only five years of data. A longer period of time is needed to establish with any confidence whether there are any secular trends in incident or damage rates.

Figure 4 shows the frequency of incidents and associated fatalities that occurred on each day of the week. Neither the incidents nor the fatalities

are distributed evenly. A perfectly even distribution would imply nine or ten incidents on each day of the week, and twelve or thirteen fatalities. Over the 1985 to 1989 period, Monday was the weekday on which both fewest incidents (five), and fewest fatalities (five) occurred. These frequencies are less than half those expected under an even distribution. Wednesday and Thursday were the least safe weekdays. These two days together accounted for 26 of the 66 incidents, or 39% of the total, and 44 of the 86 fatalities, or 51% of the total. Both percentages are significantly above the expected value of 29%, for two day totals.

The χ^2 statistics for the frequencies in Figure 4 are 7.39 and 24.37, for numbers of incidents and number of fatalities, respectively, using six degrees of freedom. We can interpret this to mean that the distribution of the number of accidents by day of week is somewhat more unbalanced than expected ($p = 30\%$), while the distribution of fatalities is very unbalanced; underlying probability of fatality occurrence independent of the day of week would give an observed distribution more unbalanced than that observed is very highly unlikely ($p << 1\%$).

No information was collected on the differences, if any, by day of the week in the numbers of workers of various kinds or of the nature and potential hazard in the work they performed, so that the implications of the uneven distribution of fatalities is unclear.

Table 7 - Number of Serious Incidents, Deaths and Hospitalizations by Year, 1985 - 1989

	Year				
	1985	1986	1987	1988	1989
Process incidents: number	9	4	11	9	7
deaths	16	7	10	18	9
hospitalizations	17	2	124	13	5
Non-process incidents: no.	4	4	6	5	7
deaths	4	5	5	5	7
hospitalizations	0	0	5	0	0

Source: API/NPRA survey

VII. Refinery Size and Complexity

Are there differences between the safety records of larger refineries and smaller ones? More specifically, what measure should be used as an index of safety, and what measure should be used as an index of size? Figure 5, Figure 6, and Figure 7 present the relation between several measures of size and the number of incidents, fatalities, and hospitalizations.

The figures require some explanation. The three measures we use here are crude oil distillation capacity, the sum of crude oil and catalytic cracking capacity together, and number of employees, in Figure 5, Figure 6, and Figure 7 respectively. In these figures the horizontal axis represents the measure of size. The refineries are sorted by size; all refineries less than and equal to any given size are to the left of the point on the axis corresponding to that size. On the vertical axis is a measure of incident damage, either fatalities, hospitalizations, or the number of incidents. Each

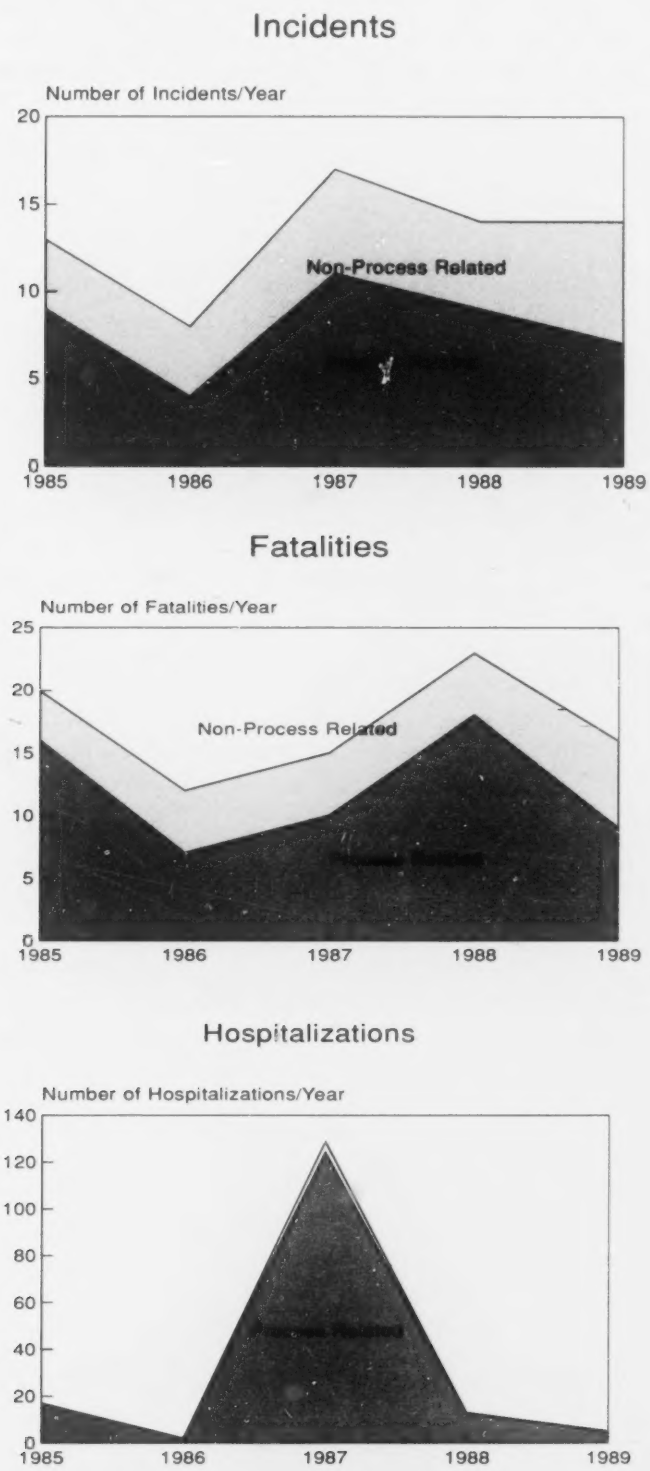


Figure 3 - Number of Incidents, Fatalities, and Hospitalizations by Year

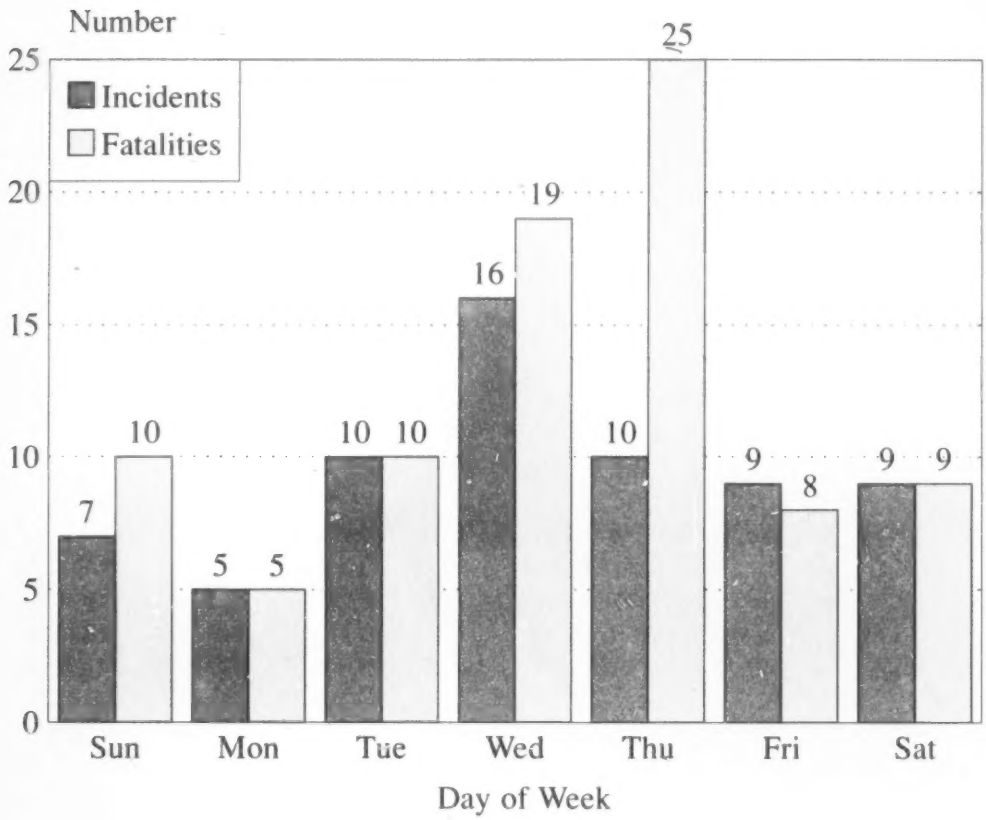


Figure 4 - Number of Incidents and Fatalities by Day of Week

point of the graphs represents the cumulative capacity (on the horizontal axis) and the cumulative incident damage (on the vertical axis) for all refineries smaller than that size. The first graph within Figure 5 shows the number of incidents versus crude oil distillation capacity. For example, the point on the curve above the 300,000 barrel per day capacity figure corresponds to 40 incidents. In other words, refineries with 300,000 barrels per day capacity or less accounted for 40 of the 66 incidents, and 12.7 million barrels per day capacity of the 15.7 total. In terms of percentages, the "300,000 barrel per day or less" refineries account for 82.3 percent of capacity and 63.9 percent of serious incidents. Since the smaller refineries (300,000 bpd or less) account for percentage of incidents that is smaller than their percentage of capacity, they have a lower serious incident rate than the larger refineries, over the 1985 to 1989 period, when using crude oil distillation capacity as a measure of size.

The straight, upward sloping lines in Figure 5, Figure 6, and Figure 7 connect the zero and 100 percent points for size and incident damage. If the relation between size and incidents were directly proportional, i. e., there was no distinction between larger and smaller refineries, the curves would follow the straight lines. When the curves are below the lines (or when the slope of the curve is greater than the slope of the straight line, the larger refineries have a higher proportion of incident damage. When the curves are above the

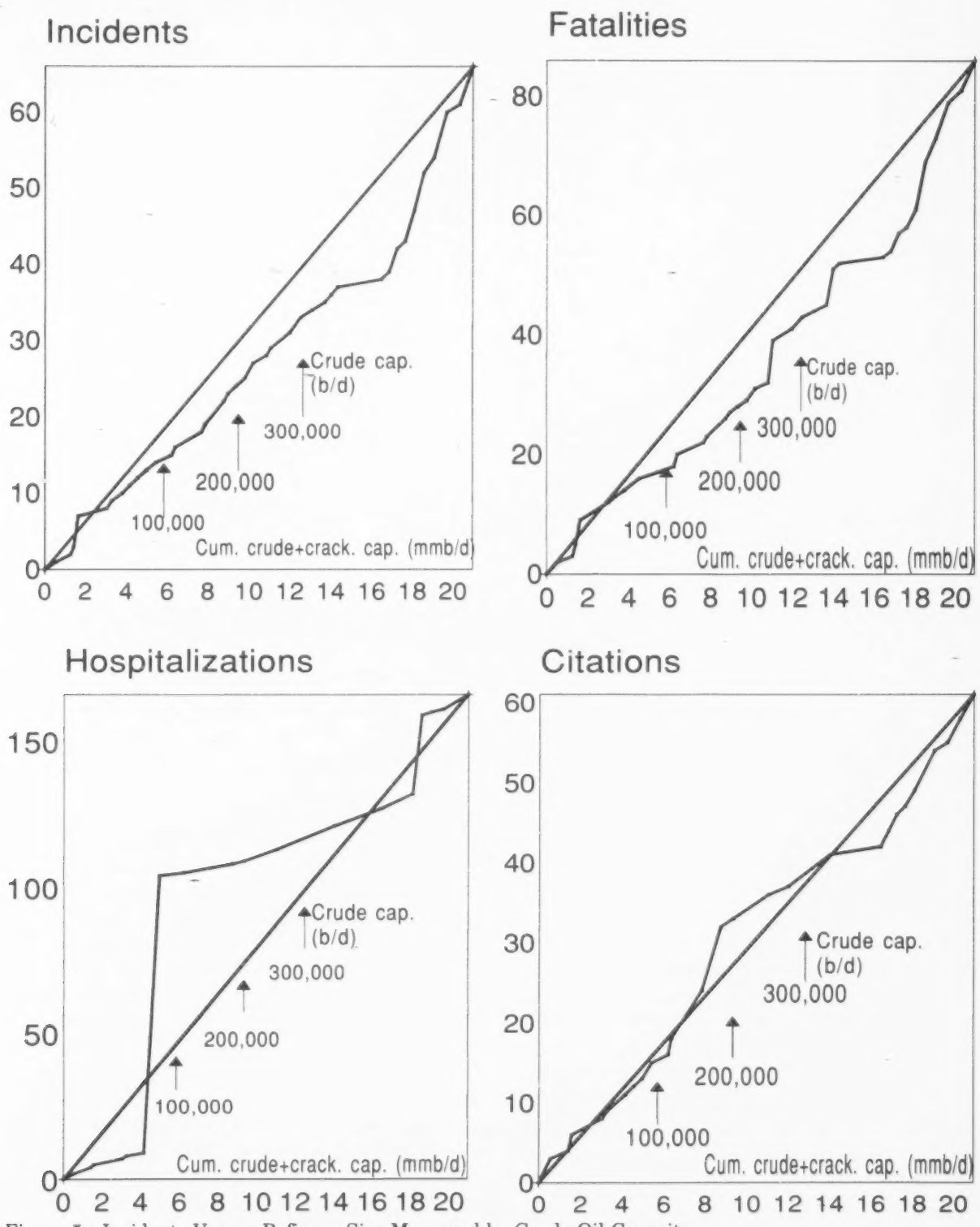


Figure 5 - Incidents Versus Refinery Size Measured by Crude Oil Capacity

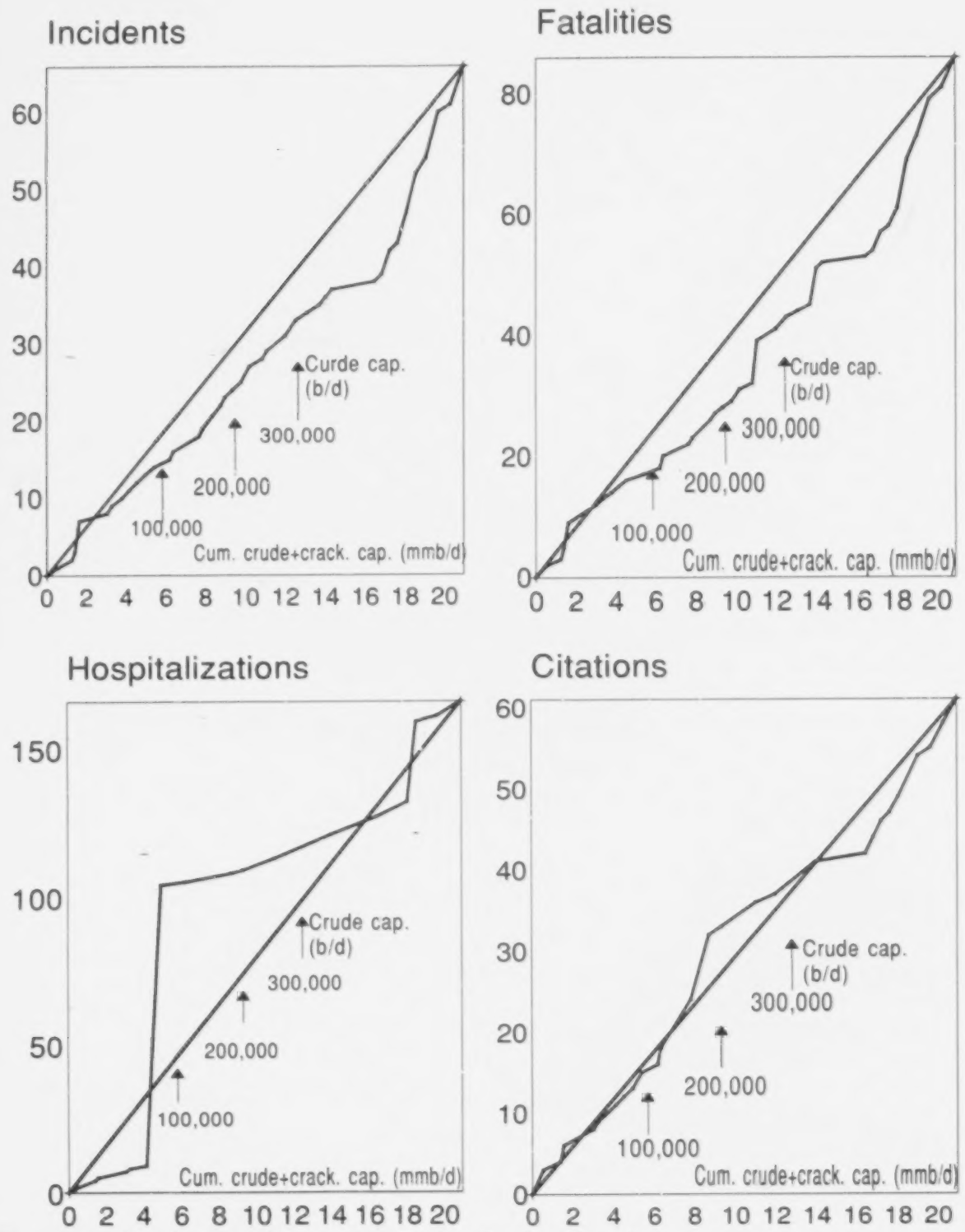


Figure 6 - Incidents Versus Refinery Size - Crude + Cracking Capacity

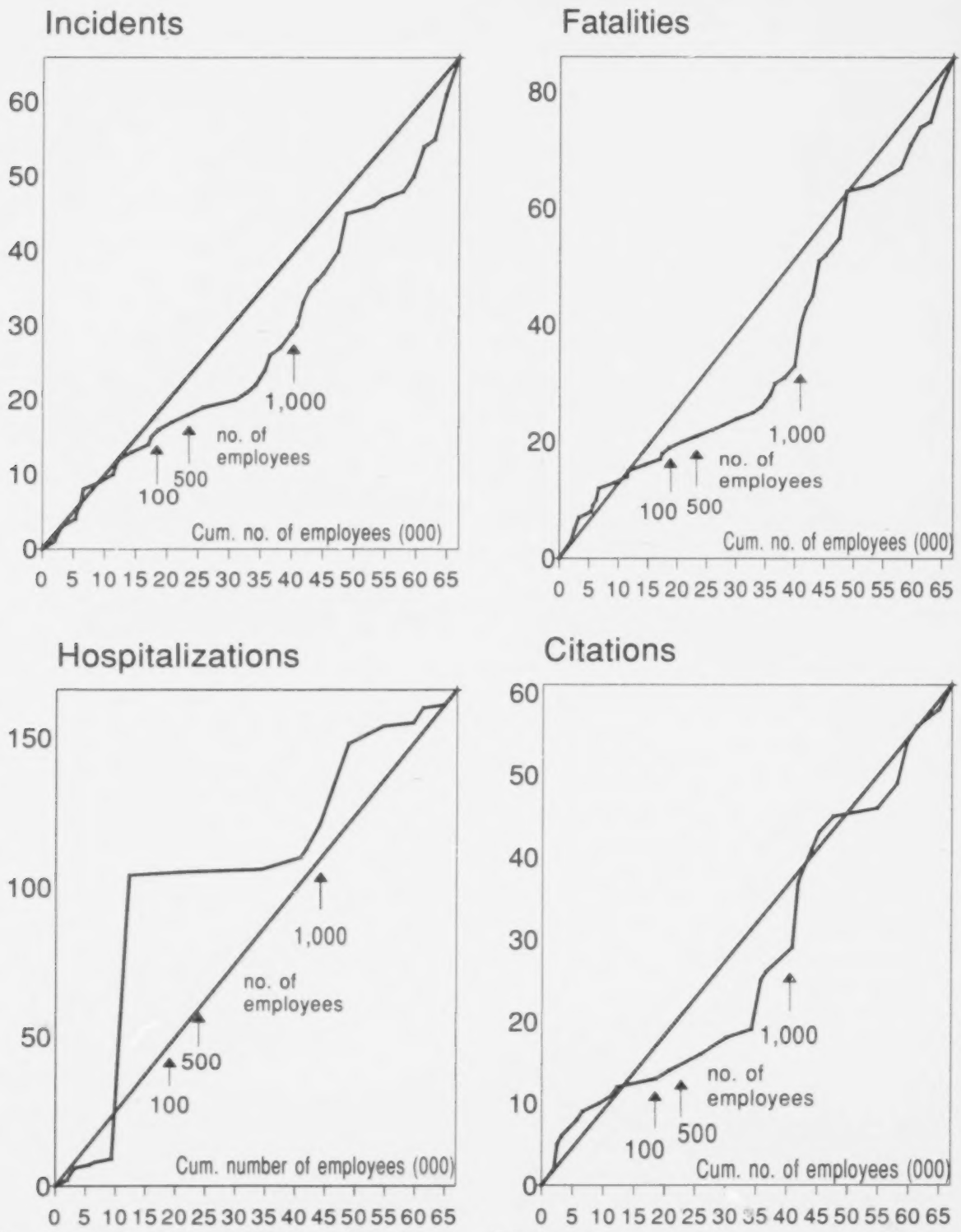


Figure 7 - Incidents Versus Refinery Size - Number of Employees

straight line, the larger refineries have a smaller proportion of damage.

For all measures of size used here, larger refineries account for a higher proportion of incidents and fatalities than smaller refineries. For hospitalizations, the smaller refineries produced more damage; as noted above, the statistics on hospitalizations are dominated by two incidents with the majority of hospitalizations. Although the general shape and curvature of the curves is similar for each measure, measures of size that account for complexity, e. g., the sum of crude distillation plus catalytic cracking capacity, lead to a more nearly linear relationship between cumulative size and cumulative incident damage.

The existing literature on industry in general suggests that the smallest and largest firms are safer than firms of intermediate size. In a 1974 survey, Oi [1974] found that the relation between injury rate and number of employees peaked at about 160 workers. The data presented here suggest the opposite, namely, that the plants of intermediate size, measured in terms of number of employees, have a somewhat higher fatality rate (but a lower rate of hospitalizations) than either the smallest or largest plants.

Unlike the other figures in this report, the detailed tabular data used to generate Figure 5, Figure 6, and Figure 7 are not given, since these figures use refinery by refinery data. The purpose of this report is to present aggregate rather than individual plant by plant data.

VIII. Measures of Incident Severity

A major concern about process related incidents is the potential for massive damage to life or property. What, for example, is the likelihood of a major incident where a large number of people are killed or injured? One piece of evidence of related to this question is the past distribution of the numbers of fatalities and injuries per incident.

Figure 8 shows the numbers of incidents by the numbers of fatalities and hospitalizations per incident. For example, there were 27 incidents with one fatality, four with two fatalities, two with three fatalities, and one each with six and seven fatalities. The distribution of hospitalizations is heavily skewed, because one incident with 95 hospitalizations accounted for the bulk of all hospitalizations reported for serious incidents.

The statistical distribution of fatalities suggests that the bulk of incidents will have relatively few fatalities, i. e., one to three. Assessing the probability of events further to the right in Figure 8, that is, the likelihood of events with eight or more fatalities, involves extrapolating from this distribution. Given the limited data, along with the inherent uncertainties associated with extrapolation of the tail of a statistical distribution, very little can be said *from this data* about the future likelihood of such events.

IX. The Distribution of Incidents Among Refineries

In the five year period studied a number of refineries reported multiple incidents, i. e., more than one incident over the five year period. Likewise, most refineries reported no incidents. Table 8 lists the number of refineries that reported having no, one, and more than one incident by the number of incidents reported. Thirty refineries reported one incident, five reported two incidents, two reported three incidents, two refineries reported five incidents, and one refinery each reported four and six incidents during the period.

At first blush this concentration of incidents in a relatively small number of refineries seems excessive. Table 8 indicates that the eleven refineries with multiple incidents reported 36 of the 66 total incidents, or just over half the total number. Should this be considered evidence that some refineries are inherently less safe than others? In order to test this hypothesis, we would have to know the expected distribution of multiple reported incidents in the absence of any differences in expected safety record among refineries. For example, consider the hypothesis that serious incidents are random, independent events, where the probability of an incident is dependent only on and proportional to refinery complexity. The measure of refinery complexity we will use here is the sum of crude distillation capacity and catalytic cracking capacity.

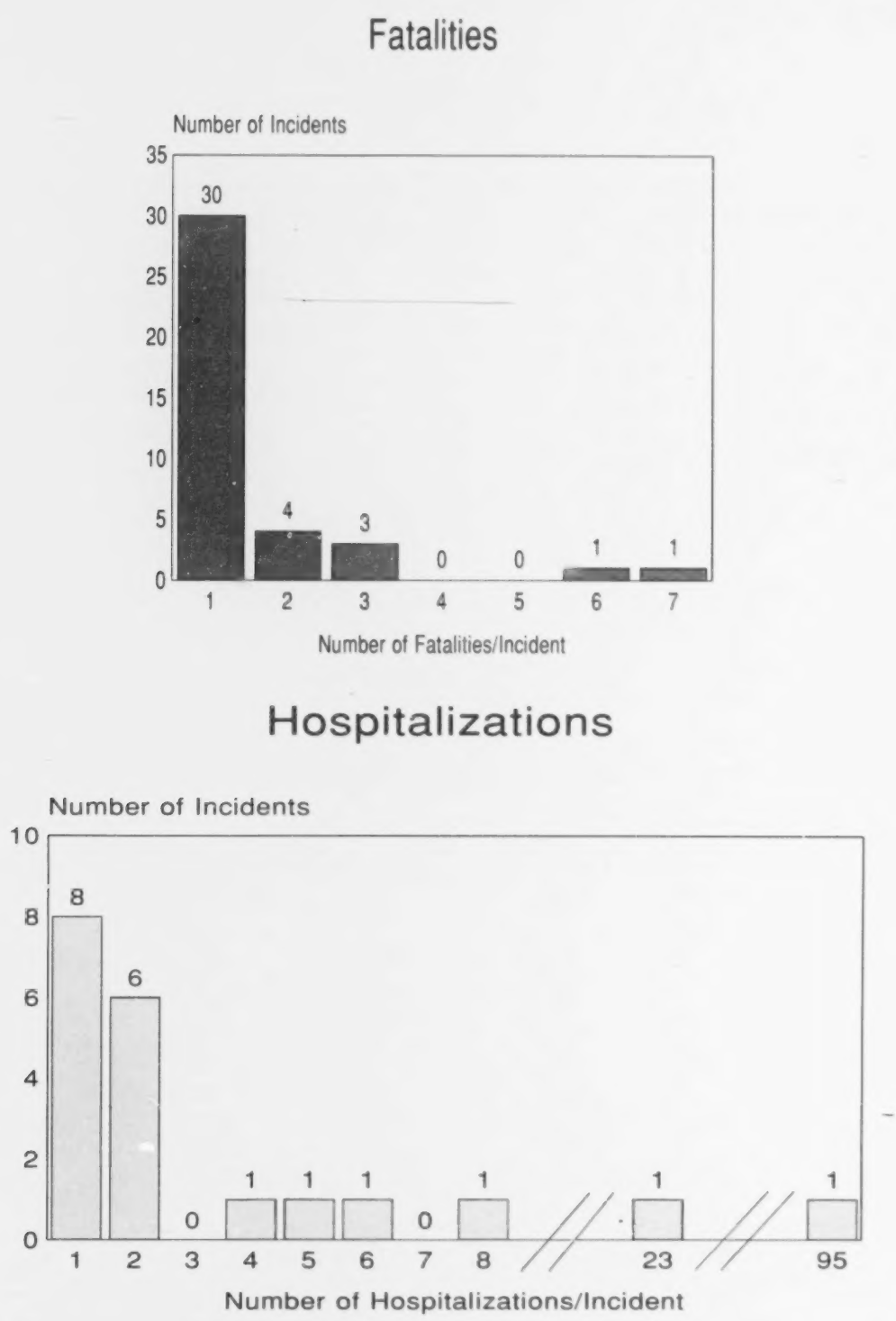


Figure 8 - The Distribution of Fatalities and Hospitalizations per Incident

The theoretical distribution of multiple reported incidents that would occur under these assumptions is difficult to calculate explicitly. We can, however, estimate the distribution by simulating repeated trials using random numbers and the assumptions of independence and that the probability of an incident is proportional to complexity. The third and fourth columns in Table 8 indicate the theoretical frequencies of reported multiple incidents, and the standard deviation of those frequencies. The statistics were produced by generating 1000 trials (the equivalent of 5000 years of data) and randomly distributing 66 incidents over the observed refinery population with the probability of an incident independent and proportional to refinery complexity.

There is substantial agreement between the theoretical and observed frequencies. As the table indicates, the expected number of refineries with no reported incidents is 120.3, compared with the 126 observed. Thirty refineries reported one incident, compared to the expected frequency of 33.135. Five refineries reported two incidents. The expected number reporting three is 9.435. The last column in the table gives the difference between reported and expected frequencies.

The sum of squared differences between expected and observed frequencies is 67.0. Based on the simulated results, the probability that the variance would be greater than 67.0 is 23.5%, and the probability that the variance would be less is 76.5%. Thus the observed distribution of incidents among refineries is somewhat different than the expected frequencies, with a slightly longer tail, but the hypothesis that the probability of an incident being independently distributed and proportional only to refinery complexity (as measured by the sum of crude distillation and catalytic cracking capacity) can not be rejected with any confidence.

Table 8 - Observed and Expected Frequencies of Number of Incidents per Refinery

	Number of Refineries			
number of incidents	observed frequency	expected frequency	expected std. deviation	observed - expected frequency
0	126	120.305	3.04	5.7
1	30	33.135	4.79	-3.1
2	5	9.435	2.66	-4.4
3	2	2.920	1.49	-.92
4	1	.860	.860	.14
5	2	.290	.506	1.71
6	1	.040	.196	.960
7	0	.015	.122	-.015
sum	167	167.		

Source: API/NPRA survey

Note: The total of 167 refineries includes seven refineries not operating in 1991 but which were operating at some time during the 1985 - 1989 period.

X. Factors Contributing to Process Related Incidents

For process related incidents, respondents were asked to list factors that contributed to the occurrence of the incident. Respondents indicated one or more contributing factors for 34 of the 40 process incidents. For the 6 incidents with no factors given, it was indicated that for five incidents nonresponse was a result of ongoing litigation and for one, information was unavailable.

Table 9 lists the factors cited and the numbers of incidents, fatalities, and hospitalizations associated with incidents where those factors were cited. There is considerable double counting in Table 9 because a number of incidents cited multiple factors. In terms of the number of times cited, the four leading factors, in decreasing number of times cited, were "Procedures", "Operation", "Unforseen or Previously Unknown Hazard", and "Design". In terms of the number of associated fatalities, the leading three factors were " Procedures", "Operation", and "Unforseen or Previously Unknown Hazard". The number of times that a contractor or contractor employee was named as a contributing factor was considerably less than the number of times the employer/employee was named. In twenty-six incidents the employer/employee and not contractor was named, in four incidents the contractor and not employer/employee was named, and in four incidents both employer/employee and contractor were named as contributing factors.

Table 9 - Factors Contributing to Process Related Incidents

Contributing factor:	Employer/employee named			Contractor named		
	no.	fatal.	hosp.	no.	fatal.	hosp.
Unforseen or prev. unk. hazard	10	18	16			
Communication	5	7	28	2	2	25
Procedures	13	17	32	5	6	27
Operation	11	14	27	6	6	25
Training	4	5	4	4	5	5
Design	9	9	7	1	1	2
Maintenance	4	5	2	1	1	23
Construction	1	1	0			
Weather	2	2	7			
Unknown	1	1	0			

Source: API/NPRA Survey

Notes: The "Operation" category includes factors that respondents categorized as "failure to follow procedures", "misconduct", "error by a properly trained employee", "operations error", "Operator error", and "instructions not followed". The totals for incidents, fatalities, and hospitalizations do not add to totals for all incidents because multiple contributing factors were cited for a number of incidents.

XI. OSHA Citations and Penalties

The survey asked for information on the number and nature of citations that OSHA issued as a result of each incident. OSHA issued citations in 32 of the 36 process related incidents. In four of the incidents, the responding refiner indicated that OSHA issued no citations. Table 10 breaks down the 62 citations issued by the severity of the citation and whether it was issued to the employer or contractor. Figure 9 illustrates the distribution. OSHA issued no "egregious" citations, the most severe category. Forty-seven of the citations, or about three quarters, were in the serious category. (For one of the citations, the category was not specified). Fifty-five citations, or 89 percent, were issued to the employers, and seven, or eleven percent, to contractors. If the relative number of citations issued is taken to be a proxy for OSHA's assignment of responsibility for the incident, then the bulk of this assignment was made to employers and not to contractors.

Table 11 attempts to correlate the number of citations issued with factors that the employer listed as contributing to the incident. The table breaks down the 40 process related incidents according to whom OSHA issued citations, and by whether employer or contractor were identified as a contributing factor to the incident. In 19 of the 40 incidents, or just under half, only the employer or direct hire employee was listed as a contributing factor, and OSHA issued the employer one or more

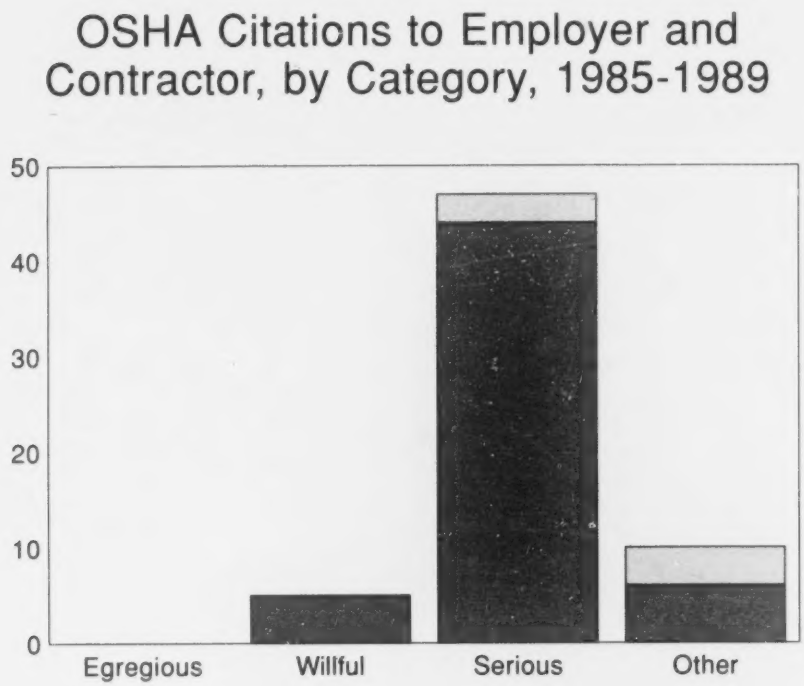


Figure 9 - Number and Nature of OSHA Citations Issued

Table 10 - Number and Nature of OSHA Citations Issued

Nature of Citation:	Number of citations issued by OSHA to:		
	Employer	Contractor	Total
Egregious	0	0	0
Willful	5	0	5
Serious	44	3	47
Other	6	4	10
Total	55	7	62

Source: API/NPRA Survey

citations. In these nineteen incidents the contractor was neither listed as a factor nor cited. The employer or direct hire employee was listed as a factor in a total of 26 of the 40 incidents, or 26 of the 34 incidents where one or more contributing factors were identified. There appears to be some agreement between the contributing factors given and the issuance of citations, although the agreement is not particularly close.

Respondents indicated that in the aftermath of 34 of the forty process related incidents, OSHA proposed penalties. No penalties were proposed after five incidents, and for one, no information was given. Fifteen of the 34 proposed penalties were $1000 or less. Eleven were between $1000 and $10,000, and two between $10,000 and $100,000. One proposed penalty exceeded $100,000, and by itself accounted for about three quarters of the dollar total of proposed penalties. In one incident, a proposed penalty was indicated with no amount specified.

XII. A Comparison With Other Industries

Lost workday rates for the refining industry are less than for manufacturing as a whole. Table 12 compares incidence rates for the refining industry to those reported for the private sector as a whole, for the year 1988. In every category, e. g., number of cases, number of lost workday cases, number of non-fatal cases without lost workdays, and number of lost workdays, rates for the refining sector are 20% or more below those for the private sector.

Table 13 shows occupational accident death rates for all manufacturing, for 1987 and 1988. The fatality rates for 1987 and 1988 were 4.3 and 3.5 per 100,000 workers per year, respectively. Our sample of refineries reported 66,905 employ-

Table 11 - Citations Versus Contributing Factor: Employer and Contractor

Who was cited by OSHA?	Who was listed as a contributing factor?				
	Employer	Contractor	Both	Neither	Total
Employer	19	2	2	6	29
Contractor	0	1	0	0	1
Both	0	1	0	0	1
Neither	7	0	2	0	9
Total	26	4	4	6	40

Source: API/NPRA Survey

Table 12 - Comparison of Refining Industry and Private Sector Incidence Rates

Incidence rates/100 full time workers - 1988		
	Private sector	Refining
Total cases	8.6	5.8
Lost workday cases	4.0	2.7
Non-fatal cases without lost workdays	4.6	3.1
Lost workdays	76.1	59.0

Source: US Bureau of Labor Statistics

ees, and 51 employee fatalities over a five year period. Based on yearly reported hours worked, we calculate a fatality rate per 100,000 employees over the 5 year period of 14.3, about three and one half times the rate for all manufacturing. Thus, if one uses fatalities as an index of how safe refineries are, they are less safe than all manufacturing. The fatality rates in construction and mining, however, are 24.5 and 33.6, respectively, considerably higher than refining. The fatality rates calculated for the refining industry from the survey data collected here may be biased upward, and not directly comparable to the BLS statistics. This is because (see II.D above) the BLS fatality rates presumably include workers other than those at the refinery sites. If the BLS employment figure of 118,100 in 1989 is used instead, and neglecting any unknown fatalities that may occur to refining employees not counted here, the fatality rate over 1985-1989 drops to 8.1, roughly double the rate for all manufacturing.

These are fatality rates for employees, and only the direct hire employee numbers and fatalities were used in calculating rates. Since the fatality rate for contractor labor is, using the data collected here, higher than that for direct hire employees, including contractor and direct hire employees together would raise the overall fatality rate some-

Table 13 - Occupational Accidental Death Rates for All Manufacturing

Work Related Fatality Rates: All Manufacturing			
year	employees (000)	fatalities	rate/100,000
1987	18,247	790	4.3
1988	18,757	660	3.5

Source: US Bureau of Labor Statistics

what below that for employees only, to 16.6 or 9.4 fatalities per 100,000 workers per year, depending on whether our survey worker total or that of the BLS is used, respectively.

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Appendix 1 - Refinery and Accident Questionnaires and Cover Letter

American Petroleum Institute
1220 L Street, Northwest
Washington, D.C. 20005
202-682-8000

March 18,1991

Name
Address

Dear Mr. :

The American Petroleum Institute (API), the National Petroleum Refiners Association (NPRA), and others in the refining and chemical industries are now participating in the Occupational Safety and Health Administration (OSHA) rulemaking to regulate the hazards of chemical processes. Further, in the Clean Air Act Amendments of 1990 (Title III, Sec. 112(r)), Congress directed both OSHA and the Environmental Protection Agency to further study and manage process safety. The purpose of this letter is to solicit your help in addressing the ongoing and future regulatory activities. The compiled information also should be useful to individual companies in managing their own safety programs.

Specifically, we would like you to provide the API and NPRA with information on certain work place incidents resulting in fatalities or hospitalizations of five or more persons which have occurred during the past five years. We need better information on the number and nature of process related incidents to support a unified industry position on managing processes involving potentially hazardous materials. We are asking you for information from the past five years.

We are sending this survey to all U. S. refiners. Your response is very important to this effort. Unless a large proportion of the refining companies respond, we will not be able to accurately characterize the industry and its record.

The information you and others supply will only be used in aggregated or summary form. We will not report information on individual incidents or companies or refineries. We will list the names of those companies who respond to this survey. When our survey effort is completed, we will return all your responses to you. We will send a copy of the report summarizing information received to all respondents.

We would greatly appreciate the return of the questionnaires to Mike Rusin, American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005, (202) 682-8533, fax (202) 682-8408 by April 29, 1991, or earlier, if at all possible.

Sincerely,

C. T. Sawyer
Vice President
American Petroleum Institute

Urvan R. Sternfels
President
National Petroleum Refiners Association

An equal opportunity employer

This survey consists of a Refinery Questionnaire and a Process Related Incident Questionnaire. Please answer a Refinery Questionnaire for each refinery that you operated during the years 1985 through 1989. Please answer a Process Incident Questionnaire for each process related incident that occurred during this same period in a refinery that you operated. In completing these questionnaires, we suggest that you consult with your legal counsel wherever appropriate.

According to US Department of Energy records your firm operated the following refineries during the 1985-1989 period: (Unless indicated otherwise below, our records indicate that you owned and operated the refinery during the entire 1985 through 1989 period).

Refinery location: City	State	Zip	Crude distillation capacity (bbl/day):

If this list is incorrect in any way, please return a corrected copy with your response. Please complete a copy of the Refinery Questionnaire for each of your domestic refineries, and a copy of the Process Related Incident Questionnaire for each qualifying incident.

Refinery Questionnaire

Please complete this questionnaire whether or not there were any work related incidents involving either a fatality or the hospitalization of five or more persons during the last five years.

1. Company name: _____

2. Facility name: _____

3. Facility address: _____

_____

4. Please list the name and telephone number of someone we can contact if we have any questions about your answers to this questionnaire.

Name: _____ Phone: _____

If you have any questions, please call Mike Rusin at the American Petroleum Institute, (202) 682-8533.

5. How many employees currently work at this refinery? _____ (Do not include contract workers, or workers who are in no way associated with refining, e. g., chemical plant workers where a refinery and chemical plant are in one location, except where the processes are operated and/or maintained by personnel normally considered part of the refinery work force. For purposes of this survey, consider olefin or other base chemical facilities to be part of chemicals, not refining.

6. Please provide the following information for each work related incident that occurred during the period from January 1, 1985 through December 31, 1989 and resulted in either a death or hospitalization of five or more persons. For the purposes of this questionnaire, a ***process related incident*** is any incident that is associated with a fire, explosion, or uncontrolled or unintentional release of energy or a hazardous or harmful substance. Hospitalization means that as a result of this incident, a person was admitted to a hospital as an in-patient, that is, stayed in the hospital at least one night.

Date of Incident	Was incident Process related? yes	no	No. of Fatalities Owner	Contractor	Other	No. of Hospitalizations Owner	Contractor	Other
_____	☐	☐	_____	_____	_____	_____	_____	_____
_____	☐	☐	_____	_____	_____	_____	_____	_____
_____	☐	☐	_____	_____	_____	_____	_____	_____
_____	☐	☐	_____	_____	_____	_____	_____	_____
_____	☐	☐	_____	_____	_____	_____	_____	_____

_____	☐	☐	____	____	____	____	____	____			
_____	☐	☐	____	____	____	____	____	____			
_____	☐	☐	____	____	____	____	____	____			
_____	☐	☐	____	____	____	____	____	____			
_____	☐	☐	____	____	____	____	____	____			

(If more space is necessary to complete this list, please attach the information to this questionnaire.) Please also complete a copy of the Process Related Incident - Questionnaire for each incident listed above that was process related.

7. Please indicate the total number of hours worked at this refinery by employees and by contractor workers for each of the years 1985 through 1989.

Are the employee/owner hours worked available from company records?
Yes ☐ No ☐ If "No", please indicate how employee/owner hours were estimated. _____

Are the contractor hours worked available from company or contractor records?
Yes ☐ No ☐ If "No", please indicate how contractor hours were estimated.
_____

	Total Hours Worked	
Year	Employee/owner	Contractor
1989	_____	_____
1988	_____	_____
1987	_____	_____
1986	_____	_____
1985	_____	_____

Process Related Incident - Questionnaire

Please complete this questionnaire for each process related incident that occurred between January 1, 1985 and December 31, 1989, and resulted in either a fatality or hospitalization of five or more persons. For purposes of this questionnaire, a *process related incident* is any incident that is associated with a fire, explosion, or uncontrolled or unintentional release of a hazardous or harmful substance. Do not fill out a copy of the questionnaire for incidents where the primary cause was a vehicular or transportation accident, a fall, electrocution, collision, physical blow, or other non-process related event. Hospitalization means that as a result of this incident, a person was admitted to a hospital as an in-patient, that is, stayed in the hospital at least one night.

In completing this questionnaire, we suggest that you consult with your legal counsel wherever appropriate.

1. Date of completion of this questionnaire _____.

2. Company name _____

3. Location of incident: Refinery name _____
   Address _____
   _____

4. Please list the name and telephone number of someone we can contact if we have any questions about your answers to this questionnaire.

   Name: _____ Phone: _____
   If you have any questions about completing this questionnaire, please call Mike Rusin, American Petroleum Institute, (202) 682-8533.

5. On what date did the incident occur? _____

6. a. What substance or mixture was released? _____
   b. What was the amount released? _____ (pounds)

7. How many fatalities or hospitalizations resulted from this incident? "Other" includes visitors, members of the public, or any other person not classified as owner or contractor.

	Owner/employee	Contractor	Other
Fatalities:	____	____	____
Hospitalizations:	____	____	____

8. Please estimate actual (or direct) property damage resulting from this incident:
   a. To the owner/employer's facility _____ ($)
   b. To third parties _____ ($)

9. Please describe this incident, or if a descriptive account is already available, please attach the description to this questionnaire.

_____
_____
_____
_____
_____
_____
_____
_____
_____

10. What factors contributed to this incident? For each of the possible factors listed below from a. to j., please indicate any known primary and contributing factors associated with the incident, for both employer and contractor. If you do not answer this question, please indicate the reason, e. g., investigation incomplete, under litigation, etc. _____

Factor	Employer	Contractor
a. Unforseen or previously unknown hazard	☐	☐
b. Communication	☐	☐
c. Procedures	☐	☐
d. Operation	☐	☐
e. Training	☐	☐
f. Design	☐	☐
g. Maintenance	☐	☐
h. Construction	☐	☐
i. Other. Please list _____	☐	☐
_____		
j. Unknown	☐	☐

11. Please provide any information you would be willing to make public regarding the degree of contractor or contractor employee involvement in this incident. _____

_____
_____
_____
_____
_____
_____
_____
_____
_____

12. Did OSHA issue any citations as a result of or related to the factors contributing to this incident? Yes ☐ No ☐

If yes;

a. How many citations did OSHA issue to the employer? _____
How many of these (employer) citations were:
egregious? _____
willful? _____
serious? _____
other than serious? _____
Did OSHA propose a penalty for the employer? Yes ☐ No ☐
If yes, what was the proposed amount? _____($)
Were citations contested, and if so, with what results? _____
_____
_____
_____
_____
_____
_____

b. How many citations did OSHA issue to the contractor? _____
How many of these (contractor) citations were:
egregious? _____
willful? _____
serious? _____
other than serious? _____
Did OSHA propose a penalty for the contractor? Yes ☐ No ☐
If yes, what was the proposed amount? _____($)
Were citations contested, and if so, with what results? _____
_____
_____
_____
_____

c. Please describe the nature of the citations.
_____
_____
_____
_____
_____
_____
_____
_____

Appendix 2 - The 1985-1989 U. S. Refinery Population

ST	City	Zip code	Crude dist capacity	Cat crack capacity	Company	-	Reply
AK	Anchorage	99502	13,000		Arco Products Company	Owner (since) 01/85	Yes
	Kenai	99611	22,500		Chevron U.S.A., Inc.	Owner (since) 01/85	Yes
	Kenai	99611	80,000		Tesoro Petroleum Corporation	Owner (since) 01/85	Yes
	North Pole	99705	105,000		MAPCO Petroleum, Inc.	Owner (since) 01/85	Yes
	Anchorage	99510	14,000		Arco Products Company	Owner (since) 01/85	Yes
	North Pole	99705	7,200		Arctic Slope Regional Corp.	Owner (since) 01/85	Yes
AL	Mobile	36611	28,000		Mobile Bay Refining Co. Coastal Corporation, The	Owner (since) 01/85 Owner (since) 09/86	Yes
	Holt		5,000		Warrior Asphalt Co. of Alabama Warrior Asphalt Refining Corp.	Owner (since) 01/85 Owner (since) 10/86	
	Saraland	36571	81,300		Louisiana Land & Exploration Co.	Owner (since) 01/85	Yes
	Tuscaloosa	35401	35,000		Hunt Refining Company	Owner (since) 01/85	Yes
	Cordova	35550	10,000		United Refining Company	Owner (since) 01/85 Idle 01/90	Yes
AR	El Dorado	71730	42,000	18,500	Tosco Corporation Ergon, Incorporated	Owner (since) 01/85 Owner (since) 05/85	Yes
	Smackover	71762	7,000		Cross Oil and Refining Co., Inc.	Owner (since) 01/85	
	Stephens	93268	4,000		Berry Petroleum Co. Crystal Refining Company, Inc. Martin Gas Sales Inc.	Owner (since) 01/85 Owner (since) 01/85 Owner (since) 01/86	
AZ	Coolidge	85228	8,500		Huntway Refining Company	Owner (since) 11/89	Yes
CA	Arroyo Grande	93420	44,000		Unocal Corporation	Owner (since) 01/85	Yes
	Bakersfield	93301	9,600		Gibson Oil & Refining Co.	Owner (since) 01/85 Idle 01/90	
	Bakersfield	93307	23,000		Kern Oil & Refining Company	Owner (since) 01/85	Yes
	Bakersfield		20,500		Paramount Petroleum Corporation	Owner (since) 01/85	

ST	City	Zip code	Crude dist capacity	Cat crack capacity	Company	-	Reply
CA	Bakersfield		20,500		Texaco Refining and Marketing	Thought Idle 08/87	
	Bakersfield	93388	15,000		San Joaquin Refining Co	Owner (since) 01/85	
	Bakersfield	93302	17,000		Sunland Refining Corporation	Owner (since) 01/85	
	Bakersfield	93302	49,000		Tosco Corporation Texaco Refining and Marketing	Owner (since) 01/85 Owner (since) 06/86	Yes
	Benicia	94150	132,000	64,000	Exxon Company U.S.A.	Owner (since) 01/85	Yes
	Benicia	94510	9,000		Huntway Refining Company	Owner (since) 01/85	Yes
	Carson	90745	30,000	11,400	Fletcher Oil & Refining Company Pauley Petroleum Inc.	Owner (since) 01/85 Owner (since) 03/88	Yes
	Carson	90749	125,000	42,000	Shell Oil Company	Owner (since) 01/85	Yes
	El Segundo	90245	327,000	62,000	Chevron U.S.A., Inc.	Owner (since) 01/85	Yes
	Carson	90749	234,000	82,000	Arco Products Company	Owner (since) 01/85	Yes
	Los Angeles		19,200		Marlex Oil & Refining Co. Western Oil Refining, Inc.	Owner (since) 01/85 Thought Idle 08/85	
	Long Beach	90806	16,200		Macmillan Oil Co., Inc. Chemoil	Owner (since) 01/85 Owner (since) 08/88	
	Long Beach		11,000		Eco Asphalt	Owner (since) 01/85 Idle 01/90	
	Long Beach	90805	44,800		Edgington Oil Company Sulfur Mountain Corp.	Owner (since) 01/85 Owner (since) 06/88	
	Martinez	74553	143,000	67,000	Shell Oil Company	Owner (since) 01/85	Yes
	Martinez	94553	143,000	60,000	Tosco Corporation	Owner (since) 01/85	Yes
	Oildale	93388			Witco Corporation	Owner (since) 01/85	
	Oxnard		5,000		Tenby Inc.	Owner (since) 01/85	
	Hercules	94547	57,000		Coastal Corporation, The Sinochem	Owner (since) 01/85 Joint Owner (since) 12/88 Joint Owner (since) 12/88	Yes
	Paramount	90723	48,000		Paramount Petroleum Corporation Paramount Acquisition Corp.	Owner (since) 01/85 Owner (since) 12/88	Yes

ST	City	Zip code	Crude dist capacity	Cat crack capacity	Company	-	Re-ply
CA	Richmond	94802	280,000	63,000	Chevron U.S.A., Inc.	Owner (since) 01/85	Yes
	Rodeo	94572	77,000		Unocal Corporation	Owner (since) 01/85	Yes
	Santa Maria	93454	10,000		Conoco, Inc.	Owner (since) 01/85	Yes
	Santa Fe	90070	48,000	13,500	Golden West Refining Co.	Owner (since) 01/85	
	Santa Fe Springs	90670	39,000	12,000	Powerine Oil Company Sargent Holdings, Ltd.	Owner (since) 01/85 Owner (since) 09/86	Yes
	South Gate	90280	8,500		Lunday Thagard Company	Owner (since) 01/85	
	Torrance	90509	130,000	63,000	Mobil Oil Corporation	Owner (since) 01/85	Yes
	Wilmington	90748	6,000		Huntway Refining Company	Owner (since) 01/85	Yes
	Wilmington	90744	60,000	28,000	Texaco Refining and Marketing	Owner (since) 01/85	Yes
	Wilmington	90744	71,000	38,000	Union Pacific Resources Co. Ultramar Inc.	Owner (since) 01/85 Owner (since) 12/88	Yes
	Wilmington	90744	111,000	47,000	Unocal Corporation	Owner (since) 01/85	Yes
CO	Commerce City	80222	35,000	8,500	Colorado Refining Company Total Petroleum, Inc.	Owner (since) 01/85 Owner (since) 06/87	Yes
	Commerce City	80022	50,000	17,000	Conoco, Inc.	Owner (since) 01/85	Yes
	Fruita	81521	16,000		Gary-Williams Energy Corporation	Owner (since) 01/89 Idle 01/90	Yes
DE	Delaware City	19706	150,000	65,000	Texaco Refining and Marketing Star Enterprise Texaco Refining and Marketing	Owner (since) 01/85 Joint Owner (since) 11/88 Joint Owner (since) 11/88	Yes
GA	Douglasville	30134	6,000		Young Refining Corporation	Owner (since) 01/85	Yes
	Savannah	31498	30,000		Amoco Oil Company	Owner (since) 01/85 Idle 01/90	Yes
HI	Ewa Beach	96707	80,000		Pacific Resources, Inc.	Owner (since) 01/85	Yes

ST	City	Zip code	Crude dist capacity	Cat crack capacity	Company	-	Reply
HI	Ewa Beach	96707	55,000	20,000	Chevron U.S.A., Inc.	Owner (since) 01/85	Yes
IL	Blue Island	60406	68,000	25,000	Clark Oil & Refining Corporation Horsham Corp.	Owner (since) 01/85 Owner (since) 11/88	Yes
	Hartford	62048	60,000	26,000	Clark Oil & Refining Corporation Horsham Corp.	Owner (since) 01/85 Owner (since) 11/88	Yes
	Joliet	60434	200,000	98,000	Mobil Oil Corporation	Owner (since) 01/85	Yes
	Robinson	62454	170,000	42,000	Marathon Petroleum Company	Owner (since) 01/85	Yes
	Lemont	60439	153,000	58,000	Unocal Corporation Petroleos de Venezuela Unocal Corporation	Owner (since) 11/85 Joint Owner (since) 11/89 Joint Owner (since) 11/89	Yes
	Wood River	62095	286,000	94,000	Shell Oil Company	Owner (since) 01/85	Yes
IN	Laketon	46943	9,500		Laketon Refining Corp. Young Refining Corporation Asphalt Materials	Owner (since) 01/85 Owner (since) 01/86 Owner (since) 02/88	Yes
	Mount Vernon	47620	22,600	8,000	Indiana Farm Bureau Cooperative	Owner (since) 01/85	Yes
	Indianapolis	46268	51,000	18,121	Rock Island Refining Corp. Marathon Petroleum Company	Owner (since) 01/85 Owner (since) 11/89	Yes
	Troy		2,500		Inter-Coastal Energy Services	Owner (since) 01/85 Idle 01/90	
	Whiting	46394	360,000	140,000	Amoco Oil Company	Owner (since) 01/85	Yes
KS	Arkansas City	67005	59,000	19,500	Total Petroleum, Inc.	Owner (since) 01/85	Yes
	Augusta	67010			Mobil Oil Corporation Williams Companies, The Coastal Corporation, The	Owner (since) 01/85 Owner (since) 05/86 Owner (since) 07/88	Yes
	Coffeyville	67337	60,723	23,000	Farmland Industries, Inc.	Owner (since) 01/85	Yes
	El Dorado	67042	83,000	31,500	Texaco Refining and Marketing	Owner (since) 01/85	Yes
	El Dorado	67042	32,000	10,000	Pester Refining Co. Coastal Corporation, The	Owner (since) 01/85 Owner (since) 04/86	Yes

ST	City	Zip code	Crude dist capacity	Cat crack capacity	Company	-	Re-ply
KS	McPherson	67460	80,000	20,000	Nat'l Cooperative Refinery Ass'n	Owner (since) 01/85	Yes
	Phillipsburg	67661	27,460		Farmland Industries, Inc.	Owner (since) 01/85	Yes
	Wichita	67214	31,300	19,800	Coastal Corporation, The	Owner (since) 01/85	Yes
KY	Catlettsburg	41129	220,000	100,000	Ashland Petroleum Company	Owner (since) 01/85	Yes
	Somerset	42502	6,300		Somerset Refinery, Inc.	Owner (since) 01/85	Yes
LA	Baton Rouge	70821	438,000	188,000	Exxon Company U.S.A.	Owner (since) 01/85	Yes
	Belle Chasse	70037	218,000	89,000	BP Oil Company	Owner (since) 01/85	Yes
	Chalmette	70044	175,000	55,000	Tenneco Oil Company	Owner (since) 01/85	Yes
					Mobil Oil Corporation	Owner (since) 12/88	
	Church Point	70525	8,800		Canal Refining Company	Owner (since) 01/85	
	Convent	70723	240,000	85,000	Texaco Refining and Marketing	Owner (since) 01/85	Yes
					Star Enterprise	Joint Owner (since) 11/88	
					Texaco Refining and Marketing	Joint Owner (since) 11/88	
	Cotton Valley	71018	8,500		Kerr-McGee Refining Corporation	Owner (since) 01/85	Yes
	Dubach		11,000		Dubach Gas Co.	Owner (since) 01/85	
	Egan		5,000		Louisiana Oil & Refining Co.	Owner (since) 01/05	
					OGC Corporation	Owner (since) 10/87	
						Thought Idle 10/88	
	Garyville	70051	263,000	90,000	Marathon Petroleum Company	Owner (since) 01/85	Yes
	Lake Charles	70606	14,000		Calcasieu Refining Co.	Owner (since) 01/85	Yes
	Krotz Springs	70750	60,000	28,000	Goldking Refining Ltd.	Owner (since) 01/85	Yes
					Hill Petroleum Company	Owner (since) 01/86	
	Lake Charles	70602	320,000	150,000	Citgo Petroleum Corporation	Owner (since) 01/85	Yes
						Joint Owner (since) 10/86	
					Petroleos de Venezuela	Joint Owner (since) 10/86	
	Lake Charles	70616	30,000		Aweco, Inc.	Owner (since) 01/85	Yes
					American International Refinery	Owner (since) 07/88	
						Idle 01/90	

ST	City	Zip code	Crude dist capacity	Cat crack capacity	Company	-	Reply
LA	Lisbon	71048	7,700		Claiborne Gasoline Co.	Owner (since) 01/85	
	Meraux	70075	80,000	35,300	Murphy Oil USA, Inc.	Owner (since) 01/85	Yes
	Norco	70079	220,000		Shell Oil Company	Owner (since) 01/85	Yes
	Norco	70079	350,000	110,000	TransAmerican Natural Gas Corp.	Owner (since) 01/85 Idle 01/90	
	Princeton	71067	4,400		Calumet Refining Company	Owner (since) 01/85	
	Port Allen	70767	47,000	19,000	Placid Oil Company	Owner (since) 01/85	Yes
	Shreveport	71133	40,000		Pennzoil Products Company	Owner (since) 01/85	Yes
	Stonewall		16,000		Sabine Resources Group	Owner (since) 01/85 Idle 01/90	
	St. Rose	70087	35,000		International Processors Hill Petroleum Company	Owner (since) 01/85 Owner (since) 06/86	Yes
	Westlake	70669	167,000	42,500	Conoco, Inc.	Owner (since) 01/85	Yes
MI	Alma	48802	51,000	19,500	Total Petroleum, Inc.	Owner (since) 01/85	Yes
	Carson City	48811	6,000		Crystal Refining Company, Inc.	Owner (since) 01/85	Yes
	Detroit	48217	72,000	27,500	Marathon Petroleum Company	Owner (since) 01/85	Yes
MN	St. Paul	55071	69,220	23,000	Ashland Petroleum Company	Owner (since) 01/85	Yes
	St. Paul	55164	195,000	55,000	Koch Refining Company	Owner (since) 01/85	Yes
MS	Lumberton	39455	6,500		Southland Oil Company	Owner (since) 01/85	Yes
	Pascagoula	39568	310,000	58,000	Chevron U.S.A., Inc.	Owner (since) 01/85	Yes
	Purvis	39475	32,000	16,000	Amerada Hess Corporation	Owner (since) 01/85	Yes
	Sandersville	39477	12,500		Southland Oil Company	Owner (since) 01/85	Yes
	Vicksburg		7,900		Vicksburg Refining Inc. Petro Source Resources Inc.	Owner (since) 01/85 Thought Idle 09/85 Owner (since) 03/87	

ST	City	Zip code	Crude dist capacity	Cat crack capacity	Company	-	Reply
MS	Vicksburg	39181	22,000		Ergon, Incorporated	Owner (since) 01/85	Yes
MT	Billings	59103	52,000	18,500	Conoco, Inc.	Owner (since) 01/85	Yes
	Billings	59103	44,000	21,000	Exxon Company U.S.A.	Owner (since) 01/85	Yes
	Great Falls	59414	7,000	2,170	Montana Refining Co. Holly Corporation	Owner (since) 01/85 Owner (since) 01/86	Yes
	Laurel	59044	42,500	13,500	Cenex-Farmers Union Central	Owner (since) 01/85	Yes
NC	Greensboro		3,000		GNC Energy Corp.	Owner (since) 01/85	
	Wilmington		10,000		ATC Petroleum Inc. City Gas & Transmission Corp.	Owner (since) 01/85 Owner (since) 02/86 Thought Idle 12/89	
ND	Mandan	58554	60,000	26,000	Amoco Oil Company	Owner (since) 01/85	Yes
NJ	Linden	07036	135,000	120,000	Exxon Company U.S.A.	Owner (since) 01/85	Yes
	Paulsboro	08066	104,000	36,000	Mobil Oil Corporation	Owner (since) 01/85	Yes
	Paulsboro	08066	47,400		Seaview Petroleum, Inc.	Owner (since) 01/85	
	Perth Amboy	08820	85,000		Chevron U.S.A., Inc.	Owner (since) 01/85	Yes
	Reading			50,000	Amerada Hess Corporation	Owner (since) 01/85	Yes
	Westville	08093	110,000	50,000	Texaco Refining and Marketing Coastal Corporation, The	Owner (since) 01/85 Owner (since) 06/85	Yes
NM	Artesia	88211	40,000	14,500	Holly Corporation	Owner (since) 01/85	Yes
	Bloomfield	87413	6,100		Thriftway Marketing Corp.	Owner (since) 01/85	Yes
	Bloomfield	81521	18,107	6,000	Gary-Williams Energy Corporation	Owner (since) 01/85	
	Gallup	87301	20,000	7,200	Giant Industries, Inc.	Owner (since) 01/85	Yes
NV			4,700		Petro Source Refining Partners	Owner (since) 01/85	

ST	City	Zip code	Crude dist capacity	Cat crack capacity	Company	-	Reply
NY	Albany	12202	45,000		Cibro Petroleum Products	Owner (since) 01/85	Yes
OH	Canton	44706	68,000	25,000	Ashland Petroleum Company	Owner (since) 01/85	Yes
	Lima	45804	180,000	36,000	BP Oil Company	Owner (since) 01/85	Yes
	Toledo	43694	130,000	55,000	BP Oil Company	Owner (since) 01/85	Yes
	Toledo	43693	129,000	60,000	Sun Refining & Marketing Company	Owner (since) 01/85	Yes
OK	Ardmore	73402	64,000	23,500	Total Petroleum, Inc.	Owner (since) 01/85	Yes
	Cyril	73029	12,500		Cyril Petrochemical Corp.	Owner (since) 01/85	Yes
	Ponca City	74603	145,000	53,000	Conoco, Inc.	Owner (since) 01/85	Yes
	Shawnee	73669	11,200		Oklahoma Refining Co. Barrett Refining Corporation	Owner (since) 01/85 Owner (since) 01/86	
	Tulsa	74101	50,000	18,000	Sinclair Oil Corporation	Owner (since) 01/85	Yes
	Tulsa	74107	90,000	28,000	Sun Refining & Marketing Company	Owner (since) 01/85	Yes
	Wynnewood	73098	50,000	18,000	Kerr-McGee Refining Corporation	Owner (since) 01/85	Yes
OR	Willbridge	97210			Chevron U.S.A., Inc.	Owner (since) 01/85	Yes
PA	Bradford	16701	10,000		Witco Corporation	Owner (since) 01/85	Yes
	Indianola	15051	8,500		American Refining Group	Owner (since) 01/85	Yes
	Marcus Hook	19061	180,000	50,000	BP Oil Company	Owner (since) 01/85	Yes
	Marcus Hook	19061	185,000	86,000	Sun Refining & Marketing Company	Owner (since) 01/85	Yes
	Philadelphia	19145	180,000	53,000	Gulf Oil Corp. Chevron U.S.A., Inc.	Owner (since) 01/85 Owner (since) 07/85	Yes
	Philadelphia	19145	130,000	29,000	Arco Products Company Atlantic Refining & Marketing Sun Refining & Marketing Company	Owner (since) 01/85 Owner (since) 10/85 Owner (since) 09/89	Yes
	Rouseville	16344	16,500		Pennzoil Products Company	Owner (since) 01/85	Yes

ST	City	Zip code	Crude dist capacity	Cat crack capacity	Company	-	Re-ply
PA	Smethport	16301	7,000		Quaker State Corporation	Owner (since) 01/85	
	Warren	16365	62,000	20,000	Coral Petroleum Co. United Refining Company	Owner (since) 01/85 Owner (since) 09/88	Yes
TN	Memphis	38109	62,000	30,000	MAPCO Petroleum, Inc.	Owner (since) 01/85	Yes
TX	Three Rivers	78071	52,000	20,000	Diamond Shamrock Refining	Owner (since) 01/85	Yes
	Abilene	79604	30,000		Pride Refining, Inc. Soberbio	Owner (since) 01/85 Owner (since) 10/85	
	Baytown	77522	448,000	170,000	Exxon Company U.S.A.	Owner (since) 01/85	Yes
	Beaumont	77704	290,000	102,000	Mobil Oil Corporation	Owner (since) 01/85	Yes
	Big Spring	79720	60,000	23,000	American Petrofina, Inc.	Owner (since) 01/85	Yes
	Borger	79008	110,000	60,000	Phillips Petroleum Company	Owner (since) 01/85	Yes
	Corpus Christi	78408	140,000	71,000	Champlin Refining & Chemicals Petroleos de Venezuela Union Pacific Resources Co. Petroleos de Venezuela	Owner (since) 01/85 Joint Owner (since) 04/87 Joint Owner (since) 04/87 Owner (since) 12/88	Yes
	Corpus Christi	78403	95,000	17,500	Coastal Corporation, The	Owner (since) 01/65	Yes
	Corpus Christi	78469	108,000	52,000	Kerr-McGee Refining Corporation	Owner (since) 01/85	Yes
	Corpus Christi	78409	130,000	42,500	Koch Refining Company	Owner (since) 01/85	Yes
	Corpus Christi	78469	29,000		Sentry Refining Inc. Trifinery	Owner (since) 01/85 Owner (since) 08/85	
	Corpus Christi	78408	21,000	65,000	Saber Refining Co. Valero Refining & Marketing co.	Owner (since) 01/85 Owner (since) 05/85	Yes
	Deer Park	77536	227,000	65,000	Shell Oil Company	Owner (since) 01/85	Yes
	Donna		4,750		Listo Petroleum Co. Donna Refinery Partners, Ltd.	Owner (since) 01/85 Owner (since) 05/87 Thought Idle 12/89	
	El Paso	79905	68,000	22,000	Chevron U.S.A., Inc.	Owner (since) 01/85	Yes

ST	City	Zip code	Crude dist capacity	Cat crack capacity	Company	-	Re-ply
TX	El Paso	77905	27,000	10,500	Texaco Refining and Marketing El Paso Refinery, LP	Owner (since) 01/85 Owner (since) 05/86	Yes
	Houston	77262	70,000	60,000	Hill Petroleum Company	Owner (since) 01/85	Yes
	Houston	77017	300,000	85,000	Lyondell Petrochemical Company	Owner (since) 01/85	Yes
	Jacksboro	76366	1,800		Eagle Refining Corp.	Owner (since) 01/85	
	Kilgore	77079	1,400		Petrolite Corp.	Owner (since) 01/85	
	Tyler	75710	49,500	18,000	Texas Eastern Corp. Crown Central Petroleum Corp.	Owner (since) 01/85 Owner (since) 12/89	
	Longview	75606	14,000		Longview Refining Associates	Owner (since) 01/85	
	Nederland	77627	120,000		Unocal Corporation	Shutdown 02/90	Yes
	Nixon	78140	17,100		Pioneer Refining Ltd. Leal Petroleum Corporation	Owner (since) 01/85 Owner (since) 01/86	
	Odessa	79760	29,500	10,500	Shell Oil Company	Owner (since) 01/85	Yes
	Port Arthur	77641	338,000	110,000	Gulf Oil Corp. Chevron U.S.A., Inc.	Owner (since) 01/85 Owner (since) 07/85	Yes
	Port Arthur	77640	115,000	36,000	American Petrofina, Inc.	Owner (since) 01/85	Yes
	Pasadena	77251	103,000	56,000	Crown Central Petroleum Corp.	Owner (since) 01/85	Yes
	Port Arthur	77641	243,000	110,000	Texaco Refining and Marketing Star Enterprise Texaco Refining and Marketing	Owner (since) 01/85 Joint Owner (since) 11/88 Joint Owner (since) 11/88	Yes
	San Antonio	78223	2,000		Howell Hydrocarbons, Inc.	Owner (since) 01/85	
	San Leon		8,600		Polo Chemical Co.	Owner (since) 01/85 Idle 01/90	
	Silsbee	77656			South Hampton Refining Company	Owner (since) 01/85	Yes
	Sunray	79086	115,000	45,000	Diamond Shamrock Refining	Owner (since) 01/85	Yes
	Sweeney	77480	195,000	87,000	Phillips Petroleum Company	Owner (since) 01/85	Yes
	Texas City	77590	460,000	195,000	Amoco Oil Company	Owner (since) 01/85	Yes
	Texas City	77592	130,000	43,500	Agway Petroleum Corp.	Owner (since) 01/85	Yes

ST	City	Zip code	Crude dist capacity	Cat crack capacity	Company	--	Reply
TX	Texas City	77592	130,000	43,500	Hill Petroleum Company	Owner (since) 08/88	Yes
	Texas City	77592	74,000	37,000	Marathon Petroleum Company	Owner (since) 01/85	Yes
	Wickett	79756	10,000		Rattlesnake Refining Corp.	Owner (since) 01/85 Idle 01/90	Yes
UT	North Salt Lake City	84302	25,000	4,400	RMT Properties, Inc.	Owner (since) 01/85	Yes
					Flying J, Inc./Big West Oil Co.	Owner (since) 01/86	
	Roosevelt	84066	8,500	6,000	Seagull Refining Co. Pennzoil Products Company	Owner (since) 01/85 Owner (since) 12/86	Yes
	Salt Lake City	84103	41,500	18,000	Amoco Oil Company	Owner (since) 01/85	Yes
	Salt Lake City	84116	46,000	18,000	Chevron U.S.A., Inc.	Owner (since) 01/85	Yes
	Woods Cross	84087	13,000		Crysen Refining, Inc.	Owner (since) 01/85	Yes
	Woods Cross	84087	26,000	8,400	Phillips Petroleum Company	Owner (since) 01/85	Yes
VA	Chester	23831	4,000		Primary Corporation	Owner (since) 01/85	Yes
	Yorktown	23690	56,000	27,500	Amoco Oil Company	Owner (since) 01/85	Yes
WA	Anacortes	98221	89,000	42,000	Shell Oil Company	Owner (since) 01/85	Yes
	Anacortes	98221	120,000	45,000	Texaco Refining and Marketing	Owner (since) 01/85	Yes
	Blaine	98230	176,000		Arco Products Company	Owner (since) 01/85	Yes
	Ferndale	98248	90,000	28,500	Mobil Oil Corporation BP Oil Company	Owner (since) 01/85 Owner (since) 12/88	Yes
	Richmond Beach	98177			Chevron U.S.A., Inc.	Owner (since) 01/85	Yes
	Tacoma	89422	12,754		Crysen Refining, Inc.	Owner (since) 01/85	Yes
	Tacoma	98421	34,500		U.S. Oil & Refining Co.	Owner (since) 01/85	Yes
WI	Superior	54880	35,000	12,600	Murphy Oil USA, Inc.	Owner (since) 01/85	Yes

ST	City	Zip code	Crude dist capacity	Cat crack capacity	Company	-	Reply
WV	Newell	26050	12,500		Quaker State Corporation	Owner (since) 01/85	Yes
	St. Mary's	26170	20,000		Quaker State Corporation	Owner (since) 01/85	
					Mid-Atlantic Fuels, Inc.	Owner (since) 12/87	
					Phoenix Refining Co.	Owner (since) 08/89	
WY	Casper	82602	41,000	13,500	Amoco Oil Company	Owner (since) 01/85	Yes
	Cheyenne	82003	40,750	12,000	RMT Properties, Inc.	Owner (since) 01/85	Yes
					Frontier Oil Corporation	Owner (since) 01/86	
	Evansville	82636	25,500	10,500	Sinclair Oil Corporation	Owner (since) 01/85	Yes
	Newcastle	82701	13,500	5,000	Wyoming Refining Company	Owner (since) 01/85	
	Sinclair	82334	55,000	21,000	Sinclair Oil Corporation	Owner (since) 01/85	Yes

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American Petroleum Institute
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